# REPTILES OCCURRING ABOVE THE WINTER SNOWLINE AT MT. KOSCIUSKO.

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## I. Introduction.

This paper was suggested by Dulhunty's observations (1947, pp. 292–295) on sub-snow temperatures at Mt. Kosciusko, and my short note which he kindly published with his work is included and expanded here.

Dulhunty placed thermometers at different depths in a peat bed and allowed them to remain throughout the winter of 1945 to determine the minimum temperatures reached at different levels. Results indicated that sub-surface winter temperatures do not fall below 32°F. even at a depth of nine inches below the surface, although atmospheric temperature at times approaches zero in autumn before the ground is covered with snow and an equilibrium temperature of 32°F. is maintained on the surface beneath winter snow for about eight months of the year.

These observations are of particular interest from the standpoint of low temperature tolerance and conditions of hibernation in reptiles. In this note I have restricted attention to the six species of lizards and two of snakes—listed below—which are non-migratory and undoubtedly live the year round on the high plateau country between the height of the Hotel Kosciusko (5,000 feet) and the summit of Mt. Kosciusko (7,308 feet).

All the reptiles are small (except *Denisonia superba*, and even this snake is much larger at lower altitudes) to avail themselves of the advantageous surface-mass ratio in absorbing heat.

There is little doubt that there will be additional records for the reptilian fauna of the Mt. Kosciusko high plateau country, but the present list may serve as a basis for future work.

## II. List of Reptiles.

### Amphibolurus diemensis (Gray).

1 (Author's Collection 1600) 1 m. west of the Hotel Kosciusko, 24.i.1943.

This lizard was caught while sunning itself on top of a granite boulder. Three specimens are recorded without definite altitudes from Mt. Kosciusko by Loveridge (1934, p. 323); one (Museum of Comparative Zoölogy 32965) "taken December 10–14, 1931, only 130 mm. in total length, holds eggs measuring 14 × 9 mm."

### Tiliqua casuarinae casuarinae (Duméril and Bibron).

1 (Museum of Comparative Zoölogy 33250) Daner's Gap, at 5,400 ft. on Mt. Kosciusko (R. J. Tillyard), 1931. "The Skink was taken in a nest of *Myrmecia pilosula*." Loveridge (1934, p. 365). Malcolm Smith (1937, p. 233) referred the genus *Omolepida*, to which this lizard was formerly attributed, to *Tiliqua*.

### Egernia whitii whitii (Lacépède).

2 (A.C. 1547–8) near Chalet, 21.i.1943.

1 (A.C. 1579) 1·2 m. from Hotel Kosciusko towards summit, 23.i.1943.

This lizard is rather uncommon at higher altitudes in contrast to its remarkable numbers near the base of the mountains.

Sphenomorphus quoyii tympanum (Lönnberg and Andersson).

4 (R 4654 etc., Aust. Mus.) Mt. Kosciusko, 3,000–7,000 ft., holotype and paratypes of *Lygosoma* (*Hinulia*) *quoyii kosciuskoi* Kinghorn. Kinghorn (1932, p. 359).

10 (M.C.Z. 33301–10) Mt. Kosciusko (Harvard Exped.) 1931. "Taken in Diggers Creek at about 5,000 ft. . . . Near the water, sometimes on rocks jutting into the stream. Occasionally takes to the water when pursued. (W.E.S.)." Loveridge (1934, p. 350).

1 (A.C. 1545) 2 m. from summit of Mt. Kosciusko, 21.i.1943.

1 (A.C. 1552) 3 m. from Betts Camp towards Hotel Kosciusko, 21.i.1943.

7 (A.C. 1559–65) 4 m. from hotel towards summit, 22.i.1943.

1 (A.C. 1580) 1·2 m. from hotel towards summit, 23.i.1943.

12 (A.C. 1583–8, 1602–7) near hotel, 23–24.i.1943.

The skink collected at the highest altitude, No. 1545, was running in wet grass in a small stream carrying melting ice and snow into the Snowy River. Many lizards were seen sunning themselves on logs, timber, pipes and stones beside Diggers Creek, near the Hotel Kosciusko, or hunting in wet grass beside the stream. They took to the water without hesitation, swimming with a quick paddling motion almost as if running on the surface. They invariably returned to the place from which they had been disturbed, often within a minute. *Sphenomorphus quoyii tympanum* is second only to *Leiolopisma entrecasteauxii* in abundance.

Leiolopisma entrecasteauxii (Duméril and Bibron).

2 (M.C.Z. 33216–7) Mt. Kosciusko at 6,500 ft. (W. E. Schevill), 1931. Loveridge (1934, p. 358).

14 (M.C.Z. 33218–32) Mt. Kosciusko at 5,400–6,000 ft. (Harvard Exped.), 1931. Loveridge (1934, p. 358).

13 (A.C. 1530–42) near summit of Mt. Kosciusko, about 7,300 ft., 20.i.1943.

1 (A.C. 1546) 3 m. from summit, near road, 21.i.1943.

1 (A.C. 1549) near Chalet, 21.i.1943.

1 (A.C. 1551) 3 m. from Betts Camp towards Hotel Kosciusko, 21.i.1943.

6 (A.C. 1553–8) 4 m. from hotel towards summit, 22.i.1943.

1 (A.C. 1568) 2·5 m. from hotel towards summit, 22.i.1943.

9 (A.C. 1569–71, 1573–8) 1·2 m. from hotel towards summit, 22–23.i.1943.

4 (A.C. 1589–91, 1601) near hotel, 23–24.i.1943.

2 (A.C. 1598–9) 1·6 m. from hotel towards summit, 24.i.1943.

Nos. 1530–42 were collected in half an hour within 50 yards of the summit on a cold but sunny afternoon. All were active although they were resting under rocks in grass and low, thick vegetation. Snow and ice were lying in patches over the grass and rock, forming tongues between the clear areas. The remaining lizards were found in rather similar circumstances or foraging actively in the grass. Many escaped in cracks and joints of granitic rocks. *Leiolopisma entrecasteauxii* is undoubtedly the most common reptile over 5,000 feet.

Hemiergis decresiensis talbingoensis Copland.

3 (R 530, R 522–3, Aust. Mus.) Mt. Kosciusko, 5,000 ft. (R. Helms) v. 1889.

I made an unsuccessful search for this lizard. The three specimens referred to here are discussed by Copland (1946, p. 77 *et al.*).

Denisonia superba (Günther).

1 (A.C. 1567) 4 m. from Hotel Kosciusko towards summit, 22.i.1943.

1 (A.C. 1581) 1·2 m. from hotel towards summit, 23.i.1943.

1 (A.C. 1593) near hotel, 23.i.1943.

Nos. 1567 and 1581 were found under large stones on wet, grassy hillsides. No. 1593 was first seen gliding through grass between Diggers Creek and the Hotel Kosciusko. When cornered, it flattened its neck to a surprising extent. The snake is known locally as the "Yellow-bellied Black Snake". Loveridge (1934, p. 284) records two specimens,

the larger 793 mm., collected on Mt. Kosciusko by W. E. Schevill in 1931, but does not give the altitude.

DENISONIA CORONOIDES (Günther).

4 (M.C.Z. 32815–8) below Dead Horse Pass, near the summit of Mt. Kosciusko (P. J. Darlington), 1931. Loveridge (1934, p. 285).

1 (A.C. 1550) 3 m. from Betts Camp towards Hotel Kosciusko, 21.i.1943.

1 (A.C. 1566) 4 m. from hotel towards summit, 22.i.1943.

1 (A.C. 1572) 1·2 m. from hotel towards summit, 22.i.1943.

1 (A.C. 1582) as preceding, 23.i.1943.

1 (A.C. 1592) near hotel, 23.i.1943.

Snakes collected on 21st and 22nd January were sluggish when uncovered and for some time made no attempt to escape. On the warmer 23rd January, No. 1582, which was found gliding through grass, was very active, and No. 1592 was sunning itself on a grassy hillside. This pretty little snake is very common. No two specimens agreed in ventral colour; different specimens were dark orange, salmon-pink, dirty white with posterior half of tail pale pink, yellowish-grey bordered by red, and yellowish becoming orange caudad, respectively.

I have collected *Tiliqua nigrolutea* Gray, *Leiolopisma trilineata* (Gray) also noted by Loveridge from Mt. Kosciusko (1934, p. 359), *L. weekesae* Kinghorn, and *L. guichenoti* (Duméril and Bibron) at elevations somewhat below 5,000 feet and believe it unlikely that they extend above this height. *Amphibolurus muricatus* (Shaw) is noted without definite elevation from Mt. Kosciusko by Loveridge (1934, p. 323).

## III. DISCUSSION.

Less work appears to have been done on the behaviour of reptiles at low temperatures with associated problems of hibernation and survival than at critical thermal levels.

Conditions at Mt. Kosciusko must be somewhat similar to those reported by Stebbins (1944, pp. 233–245) in part of Lassen Volcanic National Park, California. Stebbins says: "The season of activity for the mountain swift at this elevation (6,000 feet) is quite short . . . estimated tentatively to be between five and six months . . . during the winter the area may be covered with from two to four feet of snow, exclusive of drifts."

Cowles (1941), in a study of Californian desert reptiles in winter, says (p. 139): "A study of the hibernation preferences of 96 specimens of 14 species shows that most prefer shallow retreats, the majority lying at less than 13″, but with extremes ranging from just below the surface of the ground, where they are sometimes exposed to freezing temperatures, to a possible extreme depth of 30″, where the temperatures are relatively equable"; (p. 140) "at 6″ deep . . . 4°C. or in exceptional years even lower . . . probable range of temperature during hibernation between 0° and 20°"; (p. 137) "It is probable that individuals and species which select shallow hibernating places frequently undergo far greater ranges of temperature than those indicated here . . . In the course of an ordinary winter night, temperatures frequently fall below 0°C., while in exceptional seasons the temperatures may fall as low as −10·5°C."

Cowles and Bogert (1944, p. 294) noted that reptiles living in a Californian environment with great extremes of temperature were not voluntarily active below 16°C., and (1944, p. 279) that the lizard *Dipsosaurus dorsalis dorsalis* exposed to a temperature slightly below 8°C. was torpid and remained helpless up to 14°C., not walking with well-co-ordinated movements until the temperature was raised to 24°C.

These observations, although made under widely different conditions, indicate that reptiles seek a considerable cover to avoid freezing temperatures at the surface. Dulhunty's experiment (1947), made at an elevation of 6,200 feet, which must be regarded as typical of the high plateau covered by snow for eight or nine months of the year, shows that the minimum winter temperature a foot below the surface is slightly more than 2° F. above freezing-point, so that hibernating reptiles at this

depth have at no time to undergo the risk of formation of ice crystals in the body, and almost certain death. This freezing would not occur even at 32°F. because of the essential presence in the body fluids of substances which lower the freezing-point. Mount Kosciusko reptiles almost certainly hibernate between depths of nine inches and three feet, where, as shown by Dulhunty, they would have a margin of from 2°F. to 4·5°F. above freezing-point. Although the minimum temperatures of 34°F. and 36·5°F. recorded at these two depths must occur for only part of the winter, it seems certain that they are approached over most of the season, the temperature of 32°F. being rapidly established at the ground surface. A margin above freezing-point is therefore essential because, while reptiles can successfully endure temperatures below this point for some time, exposure for months to freezing conditions could only be expected to cause death from chilling with formation of ice crystals in the body, increased viscosity of body fluids, checked metabolism, and other disadvantageous physical and chemical changes. Dulhunty gives the average depth of soil on the slopes and hillsides as six to eighteen inches, but undoubtedly deeper soil would be available in patches if sought by reptiles for hibernation purposes. The snow cover serves an essential purpose in preventing much water from circulating through the dark humus-laden or peat-like soil and thus increasing conductivity.

It may be of interest to note here that amphibians may show great tolerance to cold. McClure (1943, pp. 265–6) gives a remarkable account of great numbers of the salamander *Ambystoma tigrinum* migrating over snow to White Water Lake, Nebraska, at temperatures just below or just above freezing-point.

## IV. Bibliography.

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